



Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

GCSE CHEMISTRY

F

Foundation Tier Paper 1

Time allowed: 1 hour 45 minutes

Materials

For this paper you must have:

- a ruler
- a scientific calculator
- the periodic table (enclosed).

Instructions

- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- In all calculations, show clearly how you work out your answer.

Information

- The maximum mark for this paper is 100.
- The marks for questions are shown in brackets.
- You are expected to use a calculator where appropriate.
- You are reminded of the need for good English and clear presentation in your answers.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	



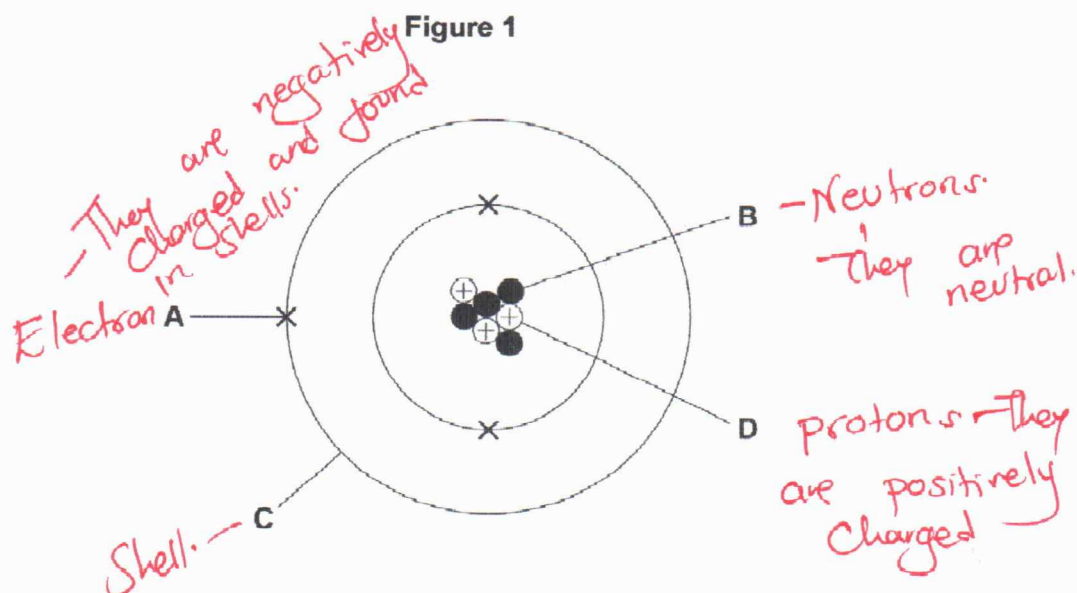
JUN 22 8 4 6 2 1 F 0 1

0 1

This question is about atoms.

0 1. 1

Figure 1 represents an atom of an element.

Draw **one** line from each name to the correct label.

[2 marks]

Name

Label

Neutron

A

B

Proton

C

D



0 1 . 2

An atom of element Y has:

- an atomic number of 9 — Number of protons = Number of electrons
- a mass number of 19. — Sum of protons and neutrons

Give the number of electrons and the number of neutrons in this atom.

Choose answers from the box.

[2 marks]

1	9	10	19	28
---	---	----	----	----

Number of electrons

9

Number of neutrons

 $19 - 9 = 10$

Question 1 continues on the next page

Turn over ►



Table 1 shows information about two isotopes of element Z.

Table 1

	Mass number	Percentage abundance (%)
Isotope A	39	93.3
Isotope B	41	6.7

0 1 . 3 Calculate the relative atomic mass (A_r) of element Z.

Use Table 1 and the equation:

$$A_r = \frac{(\text{mass number} \times \text{percentage}) \text{ of isotope A} + (\text{mass number} \times \text{percentage}) \text{ of isotope B}}{100}$$

Give your answer to 3 significant figures.

[3 marks]

$$\frac{(39 \times 93.3) + (41 \times 6.7)}{100} = 39.134$$

$$A_r (3 \text{ significant figures}) = 39.1$$



0 1 . 4 Suggest the identity of element Z.

Use the periodic table.

[1 mark]

Element Z Potassium

0 1 . 5 Complete the sentence.

Choose the answer from the box.

[1 mark]

electrons

neutrons

protons

Isotopes of the same element have different mass numbers because the isotopes
have different numbers of Neutrons.

9

Isotopes have the same number of protons
but different number of neutrons

Turn over for the next question

Turn over ►



0 2

This question is about elements, compounds and mixtures.

0 2 . 1

Which type of substance is hydrogen?

[1 mark]

Tick (✓) **one** box.

Element

☒*- made up of one type of atom.*

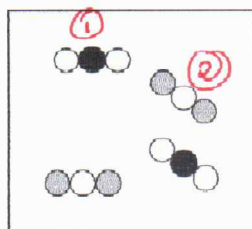
Compound

☐

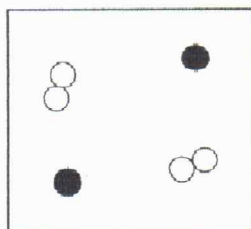
Mixture

☐The diagrams in **Figure 2** represent different substances.

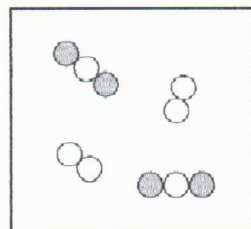
● ● and ○ represent atoms of three different elements.

Figure 2

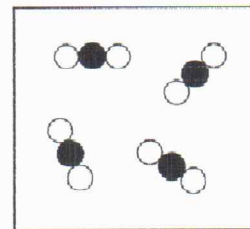
A



B



C



D

Use **Figure 2** to answer questions 02.2 and 02.3.

0 2 . 2

Which diagram represents a mixture of compounds?

Mixtures are physically bonded. No new substances is formed

[1 mark]

A ☒B ☐C ☐D ☐

0 2 . 3

Which diagram represents a mixture of elements?

[1 mark]

A ☐B ☒C ☐D ☐

Turn over ►



Substances can be separated from mixtures by using different methods.

0 2 4

Complete the sentence.

[1 mark]

Sand can be separated from a mixture of sand and water by

Filtration

A mixture of four liquids was fractionally distilled.

Figure 3 shows the apparatus used.

Figure 3

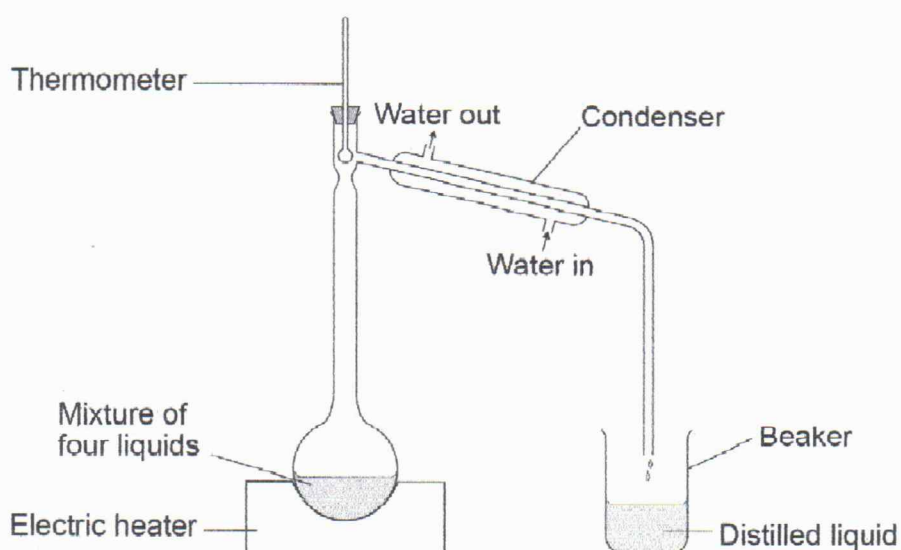


Table 2 shows the boiling points of the four liquids in the mixture.

Table 2

Liquid	Boiling point in °C
A	97
B	138
C	78
D	118



0 2 . 5

Which liquid in **Table 2** would distil and be collected in the beaker first?

[1 mark]

Liquid

C

It has the lowest
boiling point

0 2 . 6

Suggest what would happen to the temperature of the water as the water flows through the condenser.

[1 mark]

- Become lower as the cold water cools
the vapour to liquid.

0 2 . 7

Describe how to obtain sodium chloride crystals from sodium chloride solution by crystallisation.

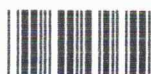
[2 marks]

Heat the solution as you stir until
crystals start to form. Once the crystals
form, remove and leave it to cool.

8

Turn over for the next question

Turn over ►



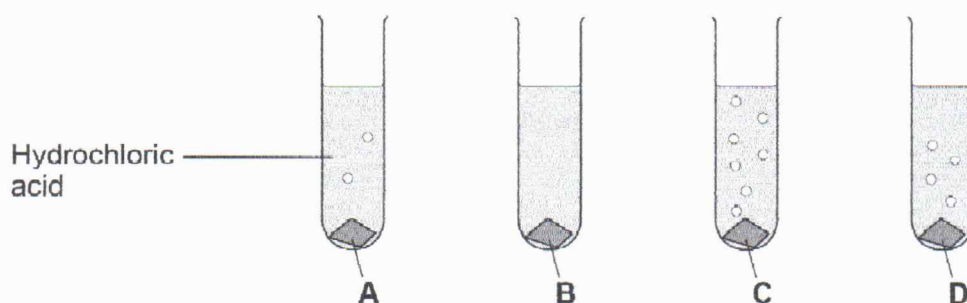
0 3

This question is about acids.

A student added four metals, A, B, C and D to hydrochloric acid.

Figure 4 shows the rate of bubbling in each tube.

Figure 4



Use Figure 4 to answer questions 03.1 and 03.2.

0 3 . 1

Which metal is copper?

Tick (✓) one box.

A ☐B ☒C ☐D ☐

Its lower than hydrogen in the reactivity series hence cannot displace hydrogen [1 mark]

0 3 . 2

Which metal is the most reactive?

Tick (✓) one box.

A ☐B ☐C ☒D ☐

More bubbles show a greater rate of reaction. [1 mark]

0 3 . 3

A metal oxide reacts with an acid to produce zinc sulfate and water.

Name the metal oxide and the acid used in this reaction.

[2 marks]

Name of metal oxide Zinc oxideName of acid Sulphuric acid

0 3 4 Universal indicator is used to measure the pH of a solution.

Draw **one** line from each pH to the colour of universal indicator in a solution with that pH.

[2 marks]

pH	Colour of universal indicator
	Blue
1	Green
7	Purple
	Red
	Yellow

Weak Alkaline (10)

Strong Alkaline (14)

Weak acid PH(4)

Question 3 continues on the next page

Turn over ►



A student reacts an acid with an alkali in a titration.

0 3 . 5

What is the type of reaction when an acid reacts with an alkali?

[1 mark]

Tick (✓) **one** box.

Combustion

☐

— burning of substances in air

Decomposition

☐

— Break down of a compound using heat

Neutralisation

☒

0 3 . 6

Figure 5 shows a piece of equipment used to measure the volume of the acid in the titration.

Figure 5



What is the name of this piece of equipment?

[1 mark]

Tick (✓) **one** box.

Burette

☒

Pipette

☐

— pipette

Syringe

☐

Tube

☐

— U Tube



0	4
---	---

Figure 6 shows an early version of the periodic table published by a scientist.

Figure 6

H							
Li	Be	B	C	N	O	F	
Na	Mg	Al	Si	P	S	Cl	
K	Ca	?	Ti	V	Cr	Mn	Fe Co Ni
Cu	Zn	?	?	As	Se	Br	
Rb	Sr	Y	Zr	Nb	Mo	?	Ru Rh Pd
Ag	Cd	In	Sn	Sb	Te	I	

0	4	.	1
---	---	---	---

Each gap is represented by a question mark (?).

[1 mark]

For elements that had not been discovered

0	4	.	2
---	---	---	---

[1 mark]

Tick (✓) **one** box.

10

10

☒

0 4 . 3

The modern periodic table is different from the periodic table in **Figure 6**.

One extra group of elements has been added.

What is the name of the extra group of elements in the modern periodic table?

[1 mark]

Tick (✓) **one** box.

Alkali metals

☐

Halogens

☐

Noble gases

☒

0 4 . 4

Why do the elements in Group 1 of the modern periodic table have similar chemical properties?

[1 mark]

Tick (✓) **one** box.

The elements all form negative ions.

☐

The elements all have one electron in the outer shell.

☒

The elements all have the same number of shells.

☐

Question 4 continues on the next page

Turn over ►



0 4 . 5 Table 3 shows the melting points of the first five elements going down Group 1.

Table 3

Element	Melting point in °C
Lithium	181
Sodium	98
Potassium	X
Rubidium	39
Caesium	29

Predict value X.

Between 98 to 39

[1 mark]

X = 63 °C

0 4 . 6 Give one observation you would see when a small piece of potassium is added to water.

[1 mark]

It floats on water, darts around, melts, fizzes and bursts into a flame



0 4 . 7 Table 4 shows information about the first five elements going down Group 7.

Table 4

Element	State at 150 °C	Symbol	Formula of the compound with hydrogen
Fluorine	gas	F	HF
Chlorine	<u>Gas</u>	Cl	HCl
Bromine	gas	Br	HBr
Iodine	liquid	I	HI
Astatine	solid	At	<u>HAt</u>

Complete Table 4.

[2 marks]

0 4 . 8 The elements in Group 7 consist of molecules.

What is the formula of a molecule of bromine?

[1 mark]

Tick (✓) **one** box.

Br

☐

Br₂

☒

Br²

☐

2Br

☐

Group 7 are diatomic

Turn over ►

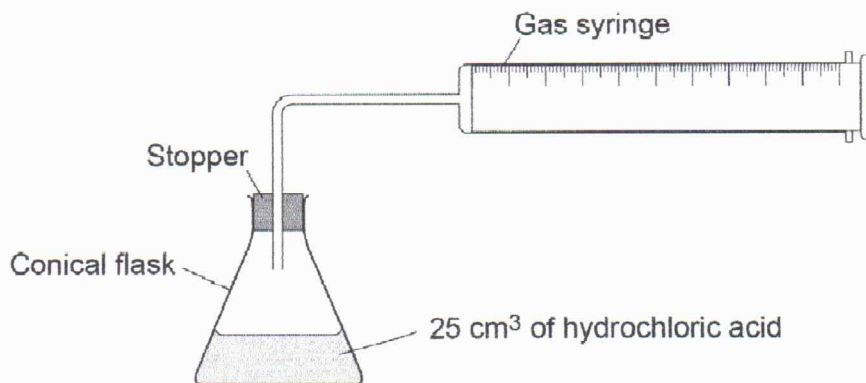


0 5

A student investigated the reaction of magnesium with hydrochloric acid.

Figure 7 shows the apparatus used.

Figure 7



This is the method used.

1. Set up the apparatus as shown in **Figure 7**.
2. Cut 10 mm of magnesium ribbon.
3. Remove the stopper.
4. Add the magnesium ribbon to the conical flask.
5. Replace the stopper as quickly as possible.
6. Record the final reading on the gas syringe when the reaction has stopped.
7. Repeat steps 1 to 6 three more times.
8. Repeat steps 1 to 7 with different lengths of magnesium ribbon.



0 5 . 1

Which gas is produced when magnesium reacts with hydrochloric acid?

[1 mark]

Tick (✓) **one** box.

Carbon dioxide

☐

Chlorine

☐

Hydrogen

☒

Oxygen

☐

0 5 . 2

What was the independent variable in the investigation?

[1 mark]

length of magnesium ribbon

0 5 . 3

Give **one** control variable in the investigation.

[1 mark]

Volume of hydrochloric acid
Concentration of hydrochloric acid

Question 5 continues on the next page

Turn over ►



Table 5 shows the results for one length of magnesium ribbon.

Table 5

	Trial 1	Trial 2	Trial 3	Trial 4
Volume of gas produced in cm ³	19	36	37	32

One of the results was anomalous.

0 5 . 4 Which trial in Table 5 gave an anomalous result?

[1 mark]

Trial 1 - Its really low.

0 5 . 5 Suggest one reason for the anomalous result in Table 5.

[1 mark]

- The reaction was incomplete
- Magnesium ribbon was short



0 5 . 6

Table 6 shows the mean volume of gas produced for each length of magnesium ribbon.

Table 6

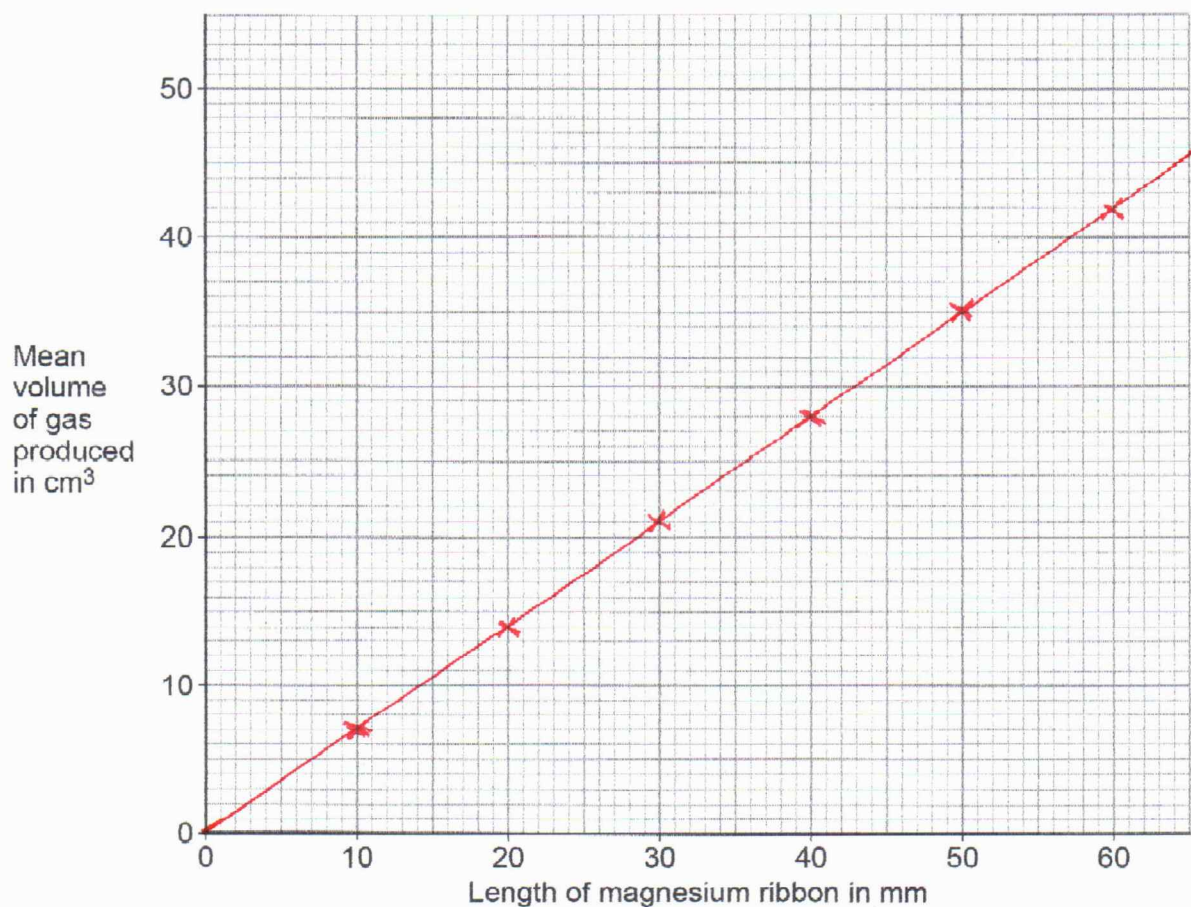
Length of magnesium ribbon in mm	10	20	30	40	50	60
Mean volume of gas produced in cm^3	7	14	21	28	35	42

Plot the data from Table 6 on Figure 8.

Draw a line of best fit.

[3 marks]

Figure 8



0 5 . 7

Complete the sentence.

[1 mark]

As the length of the magnesium ribbon increases, the mean volume of gas produced

increases.

Turn over ►

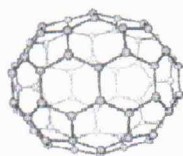


06

This question is about carbon and compounds of carbon.

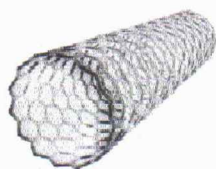
Figure 9 shows diagrams that represent different structures.

Figure 9



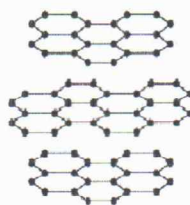
A

Buckminster



B

fullerene



C

Graphite



D

Poly(ethene)

Use Figure 9 to answer questions 06.1 and 06.2.

06.1

Which diagram represents graphite?

[1 mark]

Tick (✓) **one** box.

A

☐

B

☐

C

☒

D

☐

06.2

Which diagram represents poly(ethene)?

[1 mark]

Tick (✓) **one** box.

A

☐

B

☐

C

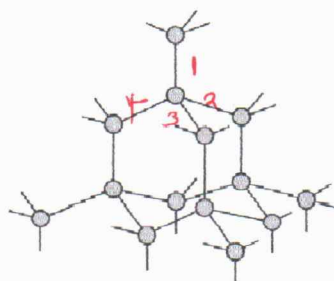
☐

D

☒

Figure 10 represents the structure of diamond.

Figure 10



Key

● Carbon atom

0 6 . 3

How many covalent bonds does each carbon atom form in diamond?

[1 mark]

4 bonds

0 6 . 4

Which is a property of diamond?

-The hardest metal.

[1 mark]

Tick (✓) **one** box.

Conducts electricity

☐

Low melting point

☐

Very hard

☒

Question 6 continues on the next page

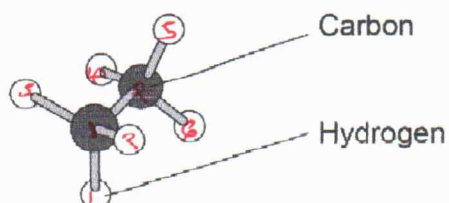
Turn over ►



0 6 . 5

Figure 11 shows a model of a molecule.

Figure 11



Complete the molecular formula of the molecule.

[1 mark]

Molecular formula = C 2 H 8

Carbonic acid is a compound of carbon.

The formula of carbonic acid is H_2CO_3 *Acid releases hydrogen ion.*

0 6 . 6

Which ion is produced by carbonic acid in aqueous solution?

[1 mark]

Tick (✓) **one** box.H⁺ ☒OH⁻ ☐O²⁻ ☐

0 6 . 7

Calculate the relative formula mass (M_r) of carbonic acid (H_2CO_3).Relative atomic masses (A_r): H = 1 C = 12 O = 16

[2 marks]

$$\begin{aligned}
 &2\text{H} + \text{C} + 3(\text{O}) \\
 &(2 \times 1) + (12) + 3 \times 16 \\
 &2 + 12 + 48
 \end{aligned}$$

Relative formula mass (M_r) = 62

8



07

This question is about small particles.

07.1

Coarse particles, fine particles and nanoparticles are all small particles.

Which is the largest particle?

[1 mark]

Tick (✓) **one** box.

Coarse particle



Fine particle



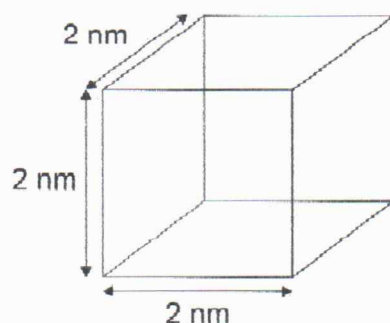
Nanoparticle



07.2

Figure 12 shows a cubic nanoparticle.

Figure 12



23

The surface area of the cubic nanoparticle is 24 nm^2 .

Calculate:

- the volume of the cubic nanoparticle
- the simplest surface area : volume ratio of the cubic nanoparticle.

[4 marks]

23

$$= 2 \times 2 \times 2$$

$$\text{Volume} = \underline{8} \text{ nm}^3$$

$$\frac{24}{8} : \frac{8}{8}$$

$$3 : 1$$

$$\text{Simplest surface area : volume ratio} = \underline{3 : 1} : 1$$

Turn over ►



07.3

Catalysts made of nanoparticles are often more effective than catalysts made of normal sized particles.

Complete the sentences.

[2 marks]

Compared with normal sized particles, the surface area to volume ratio of

nanoparticles is Larger.

This means that the mass of a nanoparticle catalyst needed to have the same effect

as the same catalyst made of normal sized particles is lower.

07.4

Silver nanoparticles can be added to the material used to make socks.

Some facts about silver and bacteria are:

- silver nanoparticles are small enough to be breathed in
- silver is very expensive
- silver can kill bacteria
- bacteria can cause infections
- bacteria can break down sweat to produce unpleasant smells.

Suggest **one** advantage and **one** disadvantage of wearing socks containing silver nanoparticles.

[2 marks]

Advantage Stops unpleasant smell

Can stop infections

Disadvantage high cost

Could be harmful if breathed in



0 7 . 5

An atom has a radius of 1×10^{-10} m.A spherical nanoparticle has a radius of 1×10^{-8} m.

How many times larger is the radius of the nanoparticle than the radius of the atom?
[1 mark]

Tick (✓) **one** box.

2 times

☐

10 times

☐

100 times

☒

200 times

☐

$$\frac{1 \times 10^{-8} \text{ m}}{1 \times 10^{-10}} = \underline{\underline{100}}$$

10

Turn over for the next question

Turn over ►



0 8

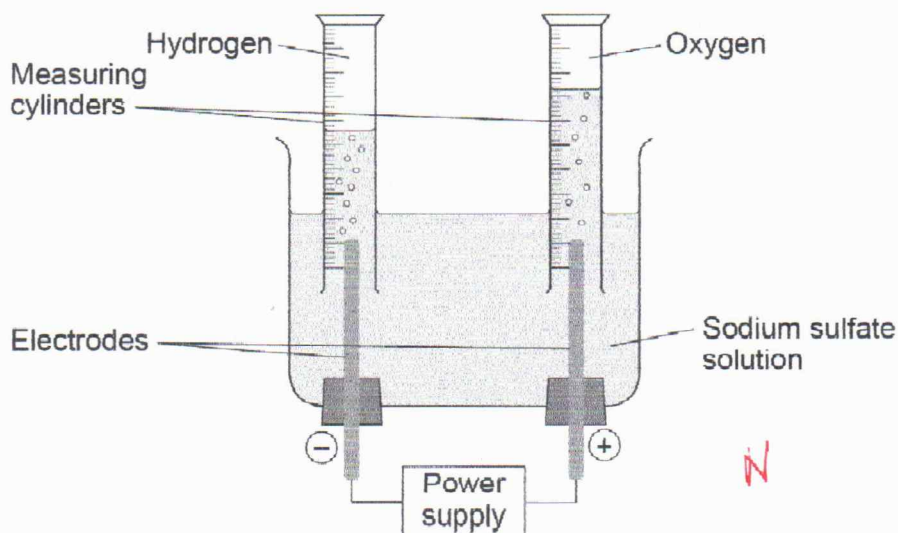
This question is about electrolysis.

Ionic compounds decompose when they are electrolysed.

A student electrolyses sodium sulfate solution.

Figure 13 shows the apparatus used.

Figure 13



0 8 . 1

Sodium sulfate solution contains:

- hydrogen ions *- turned to hydrogen gas*
- hydroxide ions *- turned to oxygen gas*
- sodium ions
- sulfate ions. *Not discharged*

Oxygen is produced at the positive electrode.

Which ions are discharged at the positive electrode to produce oxygen?

[1 mark]

Tick (✓) **one** box.

Hydrogen ions

☐

Hydroxide ions

☒

Sodium ions

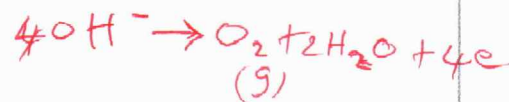
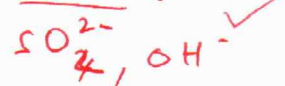
☐

Sulfate ions

☐

Anode

Anode:



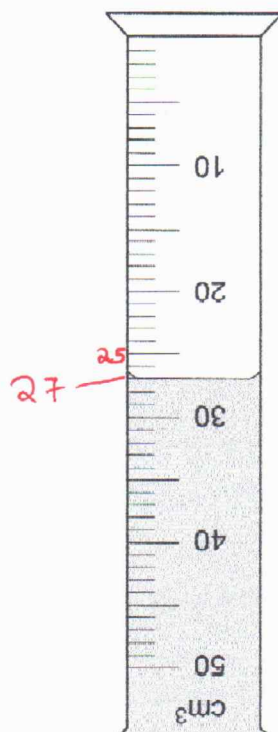
cathode:



08.2

Figure 14 shows one of the measuring cylinders during the electrolysis.

Figure 14



What is the volume of gas in the measuring cylinder?

[1 mark]

Volume of gas = 27 cm³

08.3

Ionic compounds can be electrolysed when molten or dissolved in water.

Why can ionic compounds **not** be electrolysed when solid?

You should answer in terms of ions.

[1 mark]

In solids ions are fixed and cannot
move.

Turn over ►



0 8 . 4 Table 7 shows the products of electrolysis of two molten compounds.

Table 7

Molten compound	Product at negative electrode	Product at positive electrode
Potassium iodide	Potassium	<u>Iodine</u>
Zinc bromide	<u>Zinc</u>	Bromine

Complete Table 7.

[2 marks]

0 8 . 5 The electrolysis of molten sodium chloride is used to extract sodium metal.

Why is sodium metal extracted by electrolysis instead of by reduction with carbon?

[1 mark]

Tick (✓) **one** box.

Carbon conducts electricity.

☐

Carbon is less reactive than sodium.

☒

Carbon reduction uses more energy.

☐

0 8 . 6 What is the state symbol for molten sodium chloride?

[1 mark]

Tick (✓) **one** box.

(aq) ☐

(g) ☐

(l) ☒

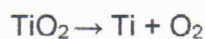
(s) ☐



0 8 . 7

Titanium can be produced from titanium oxide by electrolysis.

The equation for the reaction is:



Calculate the percentage atom economy for the production of titanium from titanium oxide by electrolysis.

Use the equation:

$$\text{Percentage atom economy} = \frac{\text{Relative atomic mass of desired product}}{\text{Relative formula mass of reactant}} \times 100$$

Relative atomic mass (A_r): Ti = 48Relative formula mass (M_r): $\text{TiO}_2 = 80$

[2 marks]

$$\frac{48}{80} \times 100$$

60%Percentage atom economy = 60 %

9

Turn over for the next question

Turn over ►

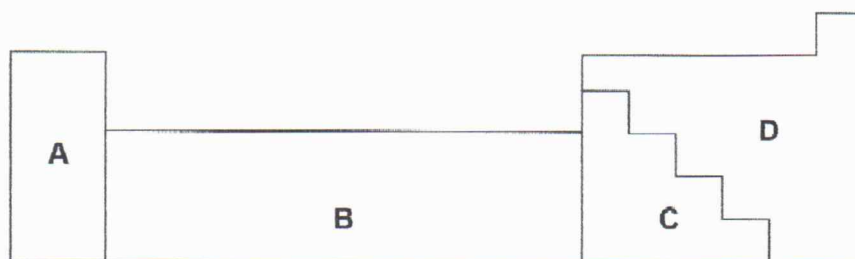


0 9

This question is about metals and non-metals.

Figure 15 shows an outline of part of the periodic table.

Figure 15

*A, B and C are metals*

0 9 . 1

Element Q is a dull solid with a melting point of 44 °C.

Element Q does not conduct electricity. *— Non metal*

Which section of the periodic table in Figure 15 is most likely to contain element Q?

[1 mark]

Tick (✓) one box.

A ☐B ☐C ☐D ☒

0 9 . 2

Element R forms ions of formula R^{2+} and R^{3+} *— Transition metals have more than 1 oxidation state*

Which section of the periodic table in Figure 15 is most likely to contain element R?

[1 mark]

Tick (✓) one box.

A ☐B ☒C ☐D ☐

0 9 . 3

Give two differences between the physical properties of the elements in Group 1 and those of the transition elements.

[2 marks]

- 1 *have a lower melting point*
have lower densities
- 2 *Softer and less strong*



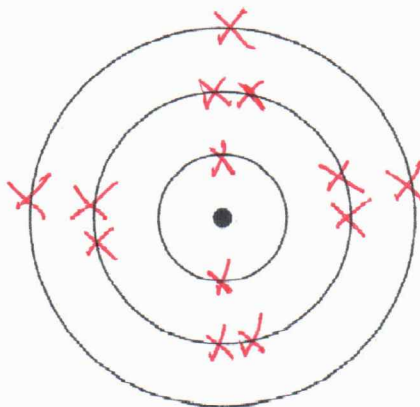
09.4

Complete **Figure 16** to show the electronic structure of an aluminium atom.

Use the periodic table.

 $Al - 2.8.3$

[1 mark]

Figure 16

09.5

Aluminium is a metal.

Describe how metals conduct electricity.

Answer in terms of electrons.

[3 marks]

Aluminium has delocalised electrons which carry charge through out the structure

09.6

Name the type of bonding in compounds formed between metals and non-metals.

[1 mark]

Ionic - Metals give electrons to Non-metals.

Turn over ►



09.7

Magnesium oxide is a compound formed from the metal magnesium and the non-metal oxygen.

Describe what happens when a magnesium atom reacts with an oxygen atom.

You should refer to electrons in your answer.

[4 marks]

Magnesium atom loses 2 electrons to form magnesium ion while oxygen atom gains 2 electrons, to form oxide ion. Electrons are transferred from a metal to a non-metal

The attraction between magnesium and oxide forms magnesium oxide.

13



1 0

Sodium carbonate reacts with hydrochloric acid in an exothermic reaction.

The equation for the reaction is:



A student investigated the effect of changing the mass of sodium carbonate powder on the highest temperature reached by the reaction mixture.

1 0 . 1

Plan a method to investigate the effect of changing the mass of sodium carbonate powder on the highest temperature reached.

[6 marks]

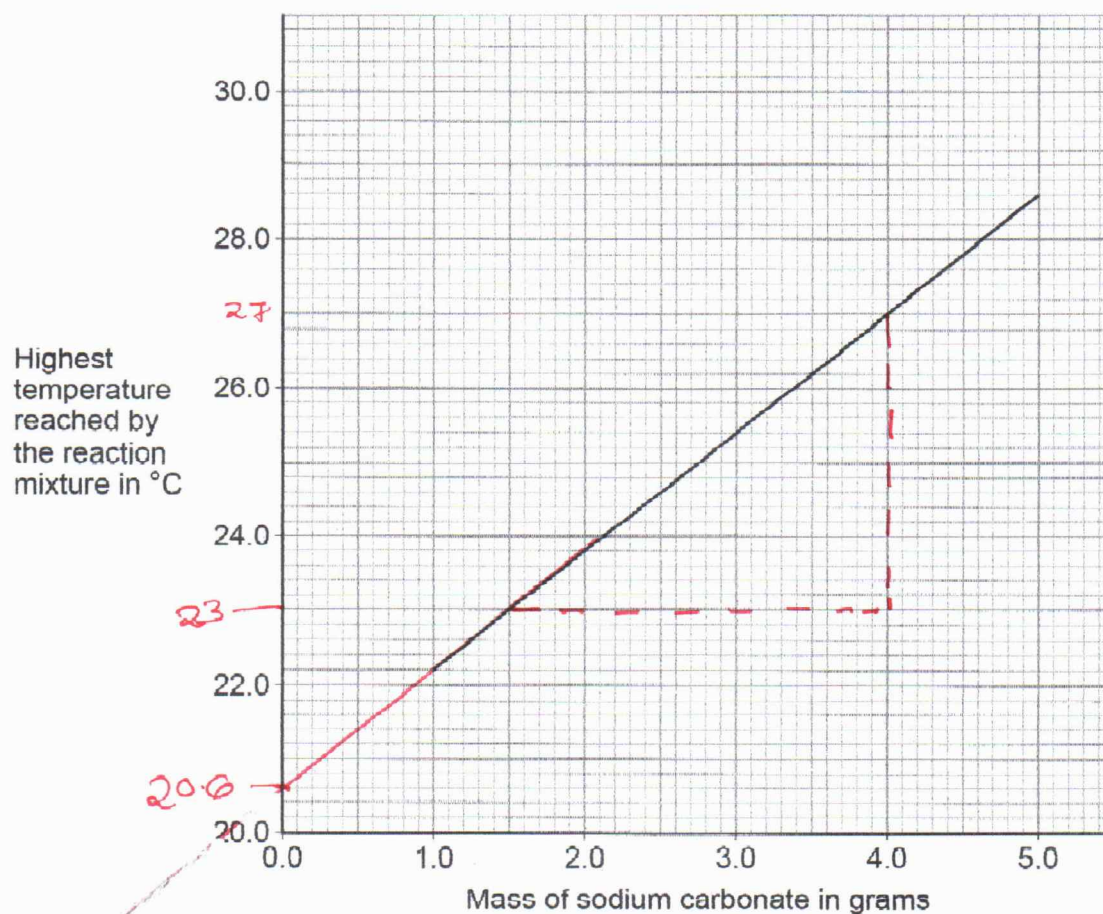
Measure the volume of hydrochloric acid using a measuring cylinder. Pour the acid into a polystyrene cup and with a thermometer, measure the initial temperature. Add a known mass of sodium carbonate measured using a balance. Stir the solution. Measure the highest temperature reached. Repeat with different masses of sodium carbonate using the same starting temperature same volume of HCl and same concentration.

Turn over ►



Figure 17 shows a line of best fit drawn through the student's results.

Figure 17



1 0 . 2

Determine the gradient of the line of best fit in **Figure 17**.

Use the equation:

$$\text{Gradient} = \frac{\text{Change in highest temperature}}{\text{Change in mass}}$$

Give the unit.

[5 marks]

$$= \frac{27 - 23}{40 - 1.5}$$

$$\frac{5^{\circ}\text{C}}{2.5\text{ g}} = 2$$

Gradient = 2.0 Unit $^{\circ}\text{C/g}$

1 0 . 3

The initial temperature of the reaction mixture is where the line of best fit would meet the y-axis.

Determine the initial temperature of the reaction mixture.

Show your working on **Figure 17**.

[2 marks]

Initial temperature of the reaction mixture = 20.6 $^{\circ}\text{C}$

Turn over ►



1 0 4

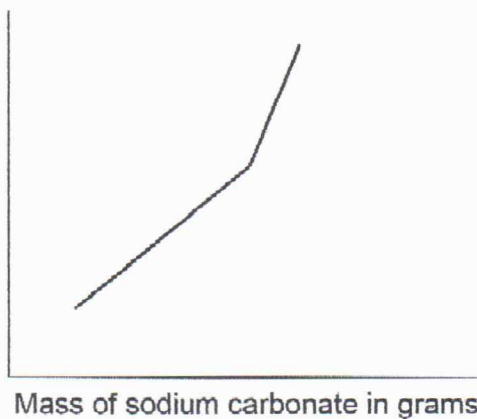
Another student repeated the investigation but added sodium carbonate until the sodium carbonate was in excess.

Which sketch graph shows the results obtained when sodium carbonate was added until in excess?

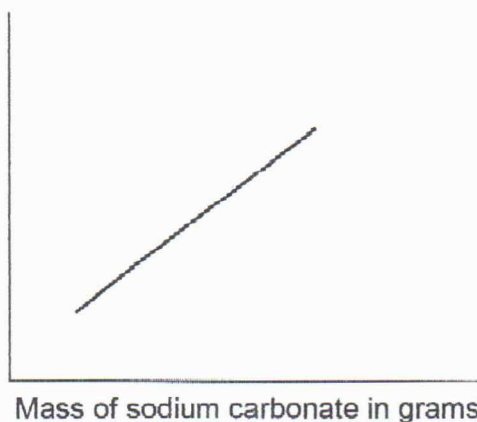
[1 mark]

Tick (✓) **one** box.

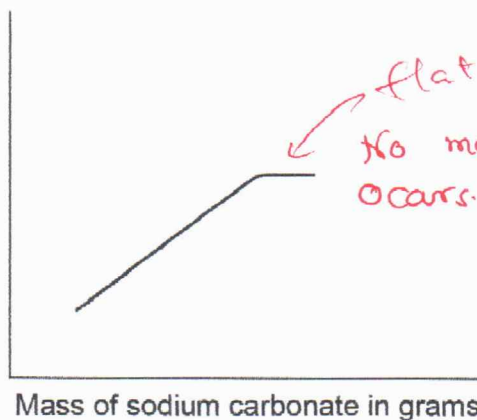
A Highest temperature reached by the reaction mixture in °C

☐

B Highest temperature reached by the reaction mixture in °C

☐

C Highest temperature reached by the reaction mixture in °C

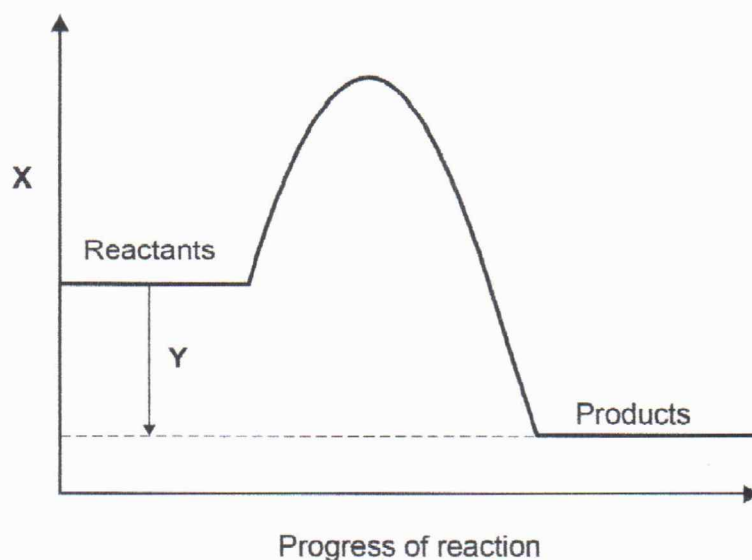


flat horizontal line
no more reaction occurs.

☐

Figure 18 shows a reaction profile for the reaction of sodium carbonate with hydrochloric acid.

Figure 18



1 0 . 5 What do labels **X** and **Y** represent on **Figure 18**?

[2 marks]

X Energy
Y Energy change

1 0 . 6 How does the reaction profile show that the reaction is exothermic?

Use **Figure 18**.

[1 mark]

The level of products is below
the level of reactants.

17

END OF QUESTIONS

